Claim Amendments

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claim 1. (Previously Presented) A process for preparing a coating fluid containing a polysiloxane, which comprises:

forming a reaction mixture comprising a silicon compound (A) of formula (1):

$$Si(OR)_4 \qquad (1)$$

wherein R is a C_{1-5} alkyl group,

a silicon compound (B) of formula (2):

$$CF_3(CF_2)_nCH_2CH_2Si(OR^1)_3 \qquad (2)$$

wherein R^1 is a C_{1-5} alkyl group, and n is an integer of from 0 to 12,

a silicon compound (C) of formula (3):

$$H_2NCONH(CH_2)_mSi(OR^2)_3 \qquad (3)$$

wherein R^2 is a C_{1-5} alkyl group, and m is an integer of from 1 to 5,

an alcohol (D) of formula (4):

$$R^3CH_2OH \qquad (4)$$

wherein R^3 is a hydrogen atom or a C_{1-12} alkyl group, wherein the alkyl group is optionally substituted by one or more substituents of the same or different types selected from the group consisting of a C_{1-3} alkyl group, a C_{1-3} hydroxyalkyl group, a C_{2-6} alkoxyalkyl group, a C_{2-6} hydroxyalkoxyalkyl group and a C_{3-6} alkoxyalkoxyalkyl group, and

oxalic acid (E), wherein

(i) the ratio of the silicon compound (B) per mol of the silicon compound (A) ranges from 0.05 to 0.43 ,

(ii) the ratio of the silicon compound (C) per mol of the silicon compound (A) ranges from 0.01 to 0.20 mol,

(iii) the ratio of the alcohol (D) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from 0.5 to 100 mol and the ratio of the oxalic acid (E) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from 0.2 to 2 mol, and

heating this reaction mixture at a temperature ranging from 40 to 180° C until the total amount of the silicon compounds (A), (B) and (C) remaining in the reaction mixture reaches at most 5 mol %, while maintaining at a SiO_2 concentration ranging from 0.5 to 10 wt % as calculated from silicon atoms in the reaction mixture and in the absence of water.

Claim 2. (Original) The process for preparing a coating fluid according to Claim 1, wherein in the formation of the reaction mixture, in addition to the silicon compounds (A), (B) and (C), the alcohol (D) and the oxalic acid (E), at least one alkylalkoxysilane selected from the group consisting of methyltrimethoxysilane, methyltriethoxysilane, ethyltrimethoxysilane, ethyltriethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, butyltrimethoxysilane, butyltriethoxysilane, pentyltrimethoxysilane, pentyltriethoxysilane, heptyltrimethoxysilane, heptyltriethoxysilane, octyltrimethoxysilane, octyltriethoxysilane, dodecyltrimethoxysilane, dodecyltriethoxysilane, hexadecyltrimethoxysilane, hexadecyltriethoxysilane, octadecyltrimethoxysilane, octadecyltriethoxysilane, phenyltrimethoxysilane, phenyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-methacryloxypropyltriethoxysilane,

dimethyldimethoxysilane and dimethyldiethoxysilane, is incorporated as a modifier (F) in a ratio ranging from 0.02 to 0.2 mol per mol of the silicon compound (A).

Claim 3. (Previously Presented) The process for preparing a coating fluid according to Claim 1, wherein at least one sol selected from the group consisting of silica sol, alumina sol, titania sol, zirconia sol, magnesium fluoride sol and ceria sol is incorporated as an additive (G) to the coating fluid.

Claim 4. (Previously Presented) A process for forming a coating film, which comprises:

forming a reaction mixture comprising a silicon compound (A) of formula (1):

$$Si(OR)_4 \qquad (1)$$

wherein R is a C_{1-5} alkyl group,

a silicon compound (B) of formula (2):

$$CF_3(CF_2)_nCH_2CH_2Si(OR^1)_3 \qquad (2)$$

wherein R^1 is a C_{1-5} alkyl group, and n is an integer of from 0 to 12,

a silicon compound (C) of formula (3):

$$H_2NCONH(CH_2)_mSi(OR^2)_3 \qquad (3)$$

wherein R^2 is a C_{1-5} alkyl group, and m is an integer ranging from 1 to 5,

an alcohol (D) of formula (4):

$$R^3CH_2OH \qquad (4)$$

wherein R^3 is a hydrogen atom or a C_{1-12} alkyl group, wherein the alkyl group is optionally substituted by one or more substituents of the same or different types selected from the group consisting of a C_{1-3} alkyl group, a C_{1-3} hydroxyalkyl group, a C_{2-6} alkoxyalkyl group, a C_{2-6} hydroxyalkoxyalkyl group and a C_{3-6} alkoxyalkoxyalkyl group, and

oxalic acid (E), wherein

(i) the ratio of the silicon compound (B) per mol of the silicon compound (A) ranges from 0.05 to 0.43 mol,

(ii) the ratio of the silicon compound (C) per mol of the silicon compound (A) ranges from 0.01 to 0.20 mol,

(iii) the ratio of the alcohol (D) per mol of the total alkoxy groups present in the silicon compounds (A), (B) and (C) ranges from 0.5 to 100 mol, and

(iv) the ratio of the oxalic acid (E) per mol of the total alkoxy groups present in the silicon compounds (A), (B) and (C) ranges from 0.2 to 2 mol;

heating this reaction mixture at a temperature ranging from 40 to 180° C until the total amount of the silicon compounds (A), (B) and (C) remaining in the reaction mixture becomes at most 5 mol %, while maintaining at a SiO_2 concentration of from 0.5 to 10 wt % as calculated from silicon atoms in the reaction mixture and in the absence of water, and

forming a solution of a polysiloxane; then

applying a coating fluid comprising the polysiloxane solution on a substrate surface to form a coating; and

heat-curing the coating at a temperature of from 40 to 450° C, to form a coating film having a refractive index of from 1.28 to 1.41 and a contact angle with water ranging from 90° to 115°, as adhered to the substrate surface.

Claim 5. (Original) The process for forming a coating film according to Claim 4, wherein in the formation of the reaction mixture, in addition to the silicon compounds (A), (B) and (C), the alcohol (D) and the oxalic acid (E), at least one alkylalkoxysilane selected from the group consisting of methyltrimethoxysilane, methyltriethoxysilane,

ethyltrimethoxysilane, ethyltriethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, butyltrimethoxysilane, butyltriethoxysilane, pentyltrimethoxysilane, pentyltriethoxysilane, heptyltrimethoxysilane, heptyltriethoxysilane, octyltrimethoxysilane, octyltriethoxysilane, dodecyltrimethoxysilane, dodecyltriethoxysilane, hexadecyltrimethoxysilane, hexadecyltriethoxysilane, octadecyltrimethoxysilane, octadecyltriethoxysilane, phenyltrimethoxysilane, phenyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-methacryloxypropyltriethoxysilane, dimethyldimethoxysilane and dimethyldiethoxysilane, is incorporated as a modifier (F) in a ratio of from 0.02 to 0.2 mol per mol of the silicon compound (A).

Claim 6. (Previously Presented) The process for forming a coating film according to Claim 4, wherein at least one sol selected from the group consisting of silica sol, alumina sol, titania sol, zirconia sol, magnesium fluoride sol and ceria sol is incorporated as an additive (G) to the coating fluid.

Claims 7-15. (Canceled)

Claim 16. (New) The process for forming a coating film according to Claim 4, wherein said SiO_2 concentration ranges from 1 to 8 wt %.

Claim 17. (New) A coating film having a refractive index ranging from 1.28 to 1.41 and a contact angle with water ranging from 90° to 115°, which is formed as adhered to a substrate surface by

forming a reaction mixture comprising a silicon compound (A) of formula (1):

$$Si(OR)_4 \qquad (1)$$

wherein R is a C_{1-5} alkyl group,

a silicon compound (B) of formula (2):

$$CF_3(CF_2)_nCH_2CH_2Si(OR^1)_3 \qquad (2)$$

wherein R^1 is a C_{1-5} alkyl group, and n is an integer of from 0 to 12,

a silicon compound (C) of formula (3):

$$H_2NCONH(CH_2)_mSi(OR^2)_3 \qquad (3)$$

wherein R^2 is a C_{1-5} alkyl group, and m is an integer ranging from 1 to 5,

an alcohol (D) of formula (4):

$$R^3CH_2OH \qquad (4)$$

wherein R^3 is a hydrogen atom or a C_{1-12} alkyl group, wherein the alkyl group is optionally substituted by one or more substituents of the same or different types selected from the group consisting of a C_{1-3} alkyl group, a C_{1-3} hydroxyalkyl group, a C_{2-6} alkoxyalkyl group, a C_{2-6} hydroxyalkoxyalkyl group and a C_{3-6} alkoxyalkoxyalkyl group), and

oxalic acid (E), wherein

(i) the ratio of the silicon compound (B) per mol of the silicon compound (A) ranges from 0.05 to 0.43 mol,

(ii) the ratio of the silicon compound (C) per mol of the silicon compound (A) ranges from 0.01 to 0.20 mol,

(iii) the ratio of the alcohol (D) per mol of the total alkoxy groups present in the silicon compounds (A), (B) and (C) ranges from 0.5 to 100 mol and the ratio of the oxalic acid (E) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from of 0.2 to 2 mol;

heating the reaction mixture at a temperature ranging from 40 to 180° C until the total amount of the silicon compounds (A), (B) and (C) remaining in the reaction mixture reaches at most 5 mol %, while maintaining at a SiO_2 concentration ranging from 0.5 to 10 wt, as calculated from silicon atoms in the reaction mixture and while in the absence of water and forming a solution of a polysiloxane; and

applying a coating fluid comprising the polysiloxane solution on a substrate surface to form a coating; and

heat-curing the coating at a temperature ranging from 40 to 450° C.

Claim 18. (New) The coating film according to Claim 17, wherein in the formation of the reaction mixture, in addition to the silicon compounds (A), (B) and (C), the alcohol (D) and the oxalic acid (E), at least one alkylalkoxysilane selected from the group consisting of methyltrimethoxysilane, methyltriethoxysilane, ethyltrimethoxysilane, ethyltriethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, butyltrimethoxysilane, butyltriethoxysilane, pentyltrimethoxysilane, pentyltriethoxysilane, heptyltrimethoxysilane, heptyltriethoxysilane, octyltrimethoxysilane, octyltriethoxysilane, dodecyltrimethoxysilane, dodecyltriethoxysilane, hexadecyltrimethoxysilane, hexadecyltriethoxysilane, octadecyltrimethoxysilane, octadecyltriethoxysilane, phenyltrimethoxysilane, phenyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-methacryloxypropyltriethoxysilane, dimethyldimethoxysilane and dimethyldiethoxysilane, is incorporated as a modifier (F) in a ratio ranging from 0.02 to 0.2 mol per mol of the silicon compound (A).

Claim 19. (New) The coating film according to Claim 17, wherein at least one sol selected from the group consisting of silica sol, alumina sol, titania sol, zirconia sol, magnesium fluoride sol and ceria sol is incorporated as an additive (G) to the coating fluid.

Claim 20. (New) A process for forming a coating film, which comprises:

forming a reaction mixture comprising a silicon compound (A) of formula (1):

$$Si(OR)_4 \qquad (1)$$

wherein R is a C_{1-5} alkyl group,

a silicon compound (B) of formula (2):

$$CF_3(CF_2)_nCH_2CH_2Si(OR^1)_3 \qquad (2)$$

wherein R^1 is a C_{1-5} alkyl group, and n is an integer ranging from 0 to 12,

a silicon compound (C) of formula (3):

$$H_2NCONH(CH_2)_mSi(OR^2)_3 \qquad (3)$$

wherein R^2 is a C_{1-5} alkyl group, and m is an integer ranging from 1 to 5,

an alcohol (D) of formula (4):

$$R^3CH_2OH \qquad (4)$$

wherein R^3 is a hydrogen atom or a C_{1-12} alkyl group, wherein the alkyl group is optionally substituted by one or more substituents of the same or different types selected from the group consisting of a C_{1-3} alkyl group, a C_{1-3} hydroxyalkyl group, a C_{2-6} alkoxyalkyl group, a C_{2-6} hydroxyalkoxyalkyl group and a C_{3-6} alkoxyalkoxyalkyl group), and

oxalic acid (E), wherein

(i) the ratio of the silicon compound (B) per mol of the silicon compound (A) ranges from 0.05 to 0.43 mol,

(ii) the ratio of the silicon compound (C) per mol of the silicon compound (A) ranges from 0.01 to 0.20 mol,

(iii) the ratio of the alcohol (D) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from 0.5 to 100 mol, and

(iv) the ratio of the oxalic acid (E) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from 0.2 to 2 mol;

heating the reaction mixture at a temperature ranging from 40 to 180° C until the total amount of the silicon compounds (A), (B) and (C) remaining in the reaction mixture reaches at most 5 mol %, while maintaining a SiO_2 concentration ranging from 0.5 to 10 wt % as calculated from silicon atoms in the reaction mixture and in the absence of water forming a solution of a polysiloxane; and

applying a coating fluid comprising the polysiloxane solution on a substrate surface to form a coating;

drying the coating at a temperature ranging from 40 to 150° C, and

aging the coating at a temperature of from 20 to 100°C for curing, to form a coating film having a refractive index of from 1.28 to 1.41 and a contact angle with water ranging from 90° to 115°, as adhered to the substrate surface.

Claim 21. (New) The process for forming a coating film according to Claim 20, wherein in the formation of the reaction mixture, in addition to the silicon compounds (A), (B) and (C), the alcohol (D) and the oxalic acid (E), at least one alkylalkoxysilane selected from the group consisting of methyltrimethoxysilane, methyltriethoxysilane, ethyltrimethoxysilane, ethyltriethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, butyltrimethoxysilane, butyltriethoxysilane, pentyltrimethoxysilane, pentyltriethoxysilane, heptyltrimethoxysilane, heptyltriethoxysilane, octyltrimethoxysilane, octyltriethoxysilane, dodecyltrimethoxysilane, dodecyltriethoxysilane, hexadecyltrimethoxysilane, hexadecyltriethoxysilane, octadecyltrimethoxysilane, octadecyltriethoxysilane,

phenyltrimethoxysilane, phenyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-methacryloxypropyltriethoxysilane, dimethyldimethoxysilane and dimethyldiethoxysilane, is incorporated as a modifier (F) in a ratio of from 0.02 to 0.2 mol per mol of the silicon compound (A).

Claim 22. (New) The process for forming a coating film according to Claim 20, wherein at least one sol selected from the group consisting of silica sol, alumina sol, titania sol, zirconia sol, magnesium fluoride sol and ceria sol is incorporated as an additive (G) to the coating fluid.

Claim 23. (New) A coating film having a refractive index ranging from 1.28 to 1.41 and a contact angle with water ranging from 90° to 115°, which is formed as adhered to a substrate surface by forming a reaction mixture comprising

a silicon compound (A) of formula (1):

$$Si(OR)_4 \qquad (1)$$

wherein R is a C_{1-5} alkyl group,

a silicon compound (B) of formula (2):

$$CF_3(CF_2)_nCH_2CH_2Si(OR^1)_3 \qquad (2)$$

wherein R^1 is a C_{1-5} alkyl group, and n is an integer of from 0 to 12,

a silicon compound (C) of formula (3):

$$H_2NCONH(CH_2)_mSi(OR^2)_3 \qquad (3)$$

wherein R^2 is a C_{1-5} alkyl group, and m is an integer of from 1 to 5,

an alcohol (D) of formula (4):

R^3CH_2OH (4)

wherein R^3 is a hydrogen atom or a C_{1-12} alkyl group, wherein the alkyl group may optionally be substituted by one or more substituents of the same or different types selected from the group consisting of a C_{1-3} alkyl group, a C_{1-3} hydroxyalkyl group, a C_{2-6} alkoxyalkyl group, a C_{2-6} hydroxyalkoxyalkyl group and a C_{3-6} alkoxyalkoxyalkyl group), and

oxalic acid (E), wherein

(i) the ratio of the silicon compound (B) per mol of the silicon compound (A) ranges from 0.05 to 0.43 mol,

(ii) the ratio of the silicon compound (C) per mol of the silicon compound (A) ranges from 0.01 to 0.20 mol,

(iii) the ratio of the alcohol (D) per mol of the total alkoxy groups present in the silicon compounds (A), (B) and (C) ranges from 0.5 to 100 mol, and

(iv) the ratio of the oxalic acid (E) per mol of the total alkoxy groups contained in the silicon compounds (A), (B) and (C) ranges from of 0.2 to 2 mol; heating the reaction mixture at a temperature ranging from 40 to 180° C until the total amount of the silicon compounds (A), (B) and (C) remaining in the reaction mixture reaches at most 5 mol %, while maintaining a SiO_2 concentration ranging from 0.5 to 10 wt % as calculated from silicon atoms in the reaction mixture and in the absence of water forming a solution of a polysiloxane;

applying a coating fluid comprising the polysiloxane solution on a substrate surface to form a coating;

drying the coating at a temperature ranging from 40 to 150° C and aging the coating at a temperature ranging from 20 to 100° C for curing.

Claim 24. (New) The coating film according to Claim 23, wherein in the formation of the reaction mixture, in addition to the silicon compounds (A), (B) and (C), the alcohol (D) and the oxalic acid (E), at least one alkylalkoxysilane selected from the group consisting of methyltrimethoxysilane, methyltriethoxysilane, ethyltrimethoxysilane, ethyltriethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, butyltrimethoxysilane, butyltriethoxysilane, pentyltrimethoxysilane, pentyltriethoxysilane, heptyltrimethoxysilane, heptyltriethoxysilane, octyltrimethoxysilane, octyltriethoxysilane, dodecyltrimethoxysilane, dodecyltriethoxysilane, hexadecyltrimethoxysilane, hexadecyltriethoxysilane, octadecyltrimethoxysilane, octadecyltriethoxysilane, phenyltrimethoxysilane, phenyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-methacryloxypropyltriethoxysilane, dimethyldimethoxysilane and dimethyldiethoxysilane, is incorporated as a modifier (F) in a ratio ranging from 0.02 to 0.2 mol per mol of the silicon compound (A).

Claim 25. (New) The coating film according to Claim 23, wherein at least one sol selected from the group consisting of silica sol, alumina sol, titania sol, zirconia sol, magnesium fluoride sol and ceria sol is incorporated as an additive (G) to the coating fluid.